Apple Assembly Line

$1.80

Volume 7 -- Issue 1 October, 1986

In This Issue...

Updated Supplement to "Beneath Apple ProDOS"

I visited Bob Christiansen at Quality Software last month, and he handed me a copy of the new supplement for "Beneath Apple ProDOS". This is the line-by-line comments for the entire BASIC.SYSTEM and PRODOS package, updated to version 1.1.1. The previous edition covered version 1.0.1 and version 1.0.2, and was obsolete by the time it was available. The new edition also is updated to version 1.1 of BASIC.SYSTEM. The price for the latest supplement is $12.50, and you must order it directly from Quality Software. As far as I know, you also must include the order page from your copy of "Beneath Apple ProDOS", or from your copy of the first edition of the Supplement.

New Version of 6805 Cross Assembler

We have now upgraded the S-C Macro 6805 Cross Assembler to Version 2.0, and it is available now for both DOS 3.3 and ProDOS. Owners of version 1.0 of this cross assembler may upgrade to the new DOS version for $20. The purchase price for either DOS or ProDOS Version 2.0 is $50, or for both is $70; if you already have one you may add the other for only $20.

Apple Finally Lifts the Lid on the IIgs

Late in September the secrecy ended. Hopefully in time for the Christmas buying binge, Apple announced the long-awaited new member of the Apple II family. The IIgs, for only $999, sports 256K RAM, a 65816 cpu running at 2.8 MHz, and greatly enhanced graphics and sound capability.

Within moments of Apple's momentous announcement, newspapers and magazines all over the world detailed the features of the new machine. Readers sent me clippings from as far away as France. Even our local Dallas Morning News was excited. By now most of you have probably visited a nearby dealer to see a demonstration, in full color and stereo sound. You have also read about the IIgs in Byte, II Computing, InCider, A+, and Nibble. Or their counterparts in other parts of the world.

With all these great sources of information, what can I add? Maybe just the personal touch, because I have a machine. We are among the lucky few picked by Apple to receive a prototype several months ago. (Apple swore us to secrecy until the great day of revelation.) What they sent us looks just like a //e from the outside, but inside there is a different motherboard. This is probably the way an upgraded //e will look. Apple has promised an upgrade kit for the //e, which involves a dealer-performed motherboard swap, for about $500. The dealer will also have to mount a new back panel, because there are a lot of built-in connectors for the built-in I/O ports.

The new motherboard looks distinctly different from any older Apples. There are still seven slots plus an auxiliary slot, but now the aux-slot is on the right side rather than the left. There is only one 28-pin ROM socket, apparently designed to hold a megabit ROM (128K bytes) but not an EPROM. That is not entirely clear, because claims are made that the ROM is expandable to 1024K bytes. Maybe they are using one of the new page-mode EPROMs. Or, more likely, Apple expects expansion ROM to be mounted on a card in the same slot that holds expansion RAM. (That slot is going to be a little crowded!) Most of the chips are soldered to the board, and many of them are "surface-mount-devices".

The RAM on the motherboard is quite different from older versions. Four 4-by-64Kbit dynamic RAM chips are soldered down on the right hand side, called "fast RAM". There are four more chips soldered on the front left side, called "slow RAM". Together, these eight chips give 256K bytes of RAM. There are also two of the same kind of chips in sockets, giving another 64K RAM, which is dedicated to the built-in music synthesizer.

The 65816 uses a 24-bit address bus. Since the chip only has 40 pins, the high byte of the address (called the "bank") is multiplexed on the data lines. There are 256 banks of 65536 bytes, giving a total of 16,777,216 bytes -- this is what we commonly call 16 megabytes. The 128K ROM on the motherboard maps into banks $FE and $FF. Expansion ROM, up to a total of one megabyte, would fill banks $F0 through $FD.

S-C Macro Assembler Version 2.0.....DOS $100, ProDOS $100, both for $120
Version 2.0 DOS Upgrade Kit for 1.0/1.1/1.2 owners.....$20
ProDOS Upgrade Kit for Version 2.0 DOS owners.....$30
Source Code of S-C Macro 2.0 (DOS only).....additional $100
Full Screen Editor for S-C Macro (with complete source code).....$49
S-C Cross Reference Utility.....without source code $20, with source $50
RAK-Ware DISASM.....without source code $30, with source $50
S-C Word Processor (with complete source code).....$50
DP18 Source and Object.....$50
Double Precision Floating Point for Applesoft (with source code).....$50
ES-CAPE (Extended S-C Applesoft Program Editor).....
Including Version 2.0 With Source Code.....$50
ES-CAPE Version 2.0 and Source Code Update (for Registered Owners)....$30
Bag of Tricks 2 (Quality Software).....($49.95) $45 *
Copy II Plus (Central Point Software).....($39.95) $35 *
Applesoft Toolbox Series (Roger Wagner Publishing).....each ($39.95) $36 *
all four ($159.80) $140 *
MacASM -- Macro Assembler for MacIntosh (Mainstay).....($150.00) $100 *
S-C Documentor (complete commented source code of Applesoft ROMs).....$50
Cross Assemblers for owners of S-C Macro Assembler.....$32.50 to $50 each
(Available: 6800/1/2, 6301, 6805, 6809, 68000, Z-80, Z-8, 8048,
8051, 8085, 1802/4/5, PDP-11, GI1650/70, others)

AAL Quarterly Disks.....each $15, or any four for $45
Each disk contains the source code from three issues of AAL:
Jan-Mar, Apr-Jun, Jul-Sep, and Oct-Dec.
(All source code is formatted for S-C Macro Assembler. Other assemblers require some effort to convert file type and edit directives.)

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"Programming the 65816", Eyes.....($22.95) $21 *
"Apple //e Reference Manual", Apple Computer.....($24.95) $23 *
"Apple //c Reference Manual", Apple Computer.....($24.95) $23 *
"ProDOS Technical Reference Manual", Apple Computer.....($29.95) $27 *
"Now That You Know Apple Assembly Language...", Gilder.....($19.95) $18 *
"Apple ProDOS: Advanced Features for Programmers", Little..($17.95) $17 *
"Inside the Apple //c", Little.....($19.95) $18 *
"Inside the Apple //e", Little.....($19.95) $18 *
"Apple II+/IIe Troubleshooting & Repair Guide", Brenner.....($19.95) $18 *
"Apple][Circuit Description", Gayler.....($22.95) $21 *
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The 128K bytes of "fast RAM" occupy banks $00 and $01. The 128K bytes of "slow RAM" occupy banks $E0 and $E1. Slow RAM is synchronized to the video output, running at about 1 MHz. When bytes are read from or written into these banks, the processor slows down to a 1MHz rate during the store cycle. During Apple II emulation, these banks act as "shadow" RAM, with the program actually running in "fast RAM" in banks $00 and $01. Any time a byte is stored into one of the video areas ($400-BFF or $2000-5FFF of either bank $00 or $01), the process slows down and the byte is also stored in the shadow RAM. When a byte is read from one of these areas, it is read only from the fast RAM copy and the processor does not have to slow down. All of the I/O addresses are in bank $E0, from $E0C000 through $E0CFFF. I assume that when you are in Apple II emulation mode these must be mapped also into bank $00, and I assume the processor slows down when these addresses are accessed.

Apple says that expansion RAM will map into banks $02 through $7F. Since several manufacturers have already announced 8 Megabyte expansion cards, I assume there are two more banks used at $80 and $81. But maybe not: perhaps the 8Meg cards leave 128K not addressable.

The memory map, the way Apple tells it, leaves two big sections unused, probably considered by Apple to be reserved. Banks $80-$DF and banks $E2-EF add up to almost seven megabytes still not taken.

There is also some battery-backed-up RAM in there somewhere, possibly inside the clock-calendar chip. The IIgs remembers how you have configured all the serial ports, what colors you want to use for text (letters, background, and border), how loud to ring the bell, and other interesting parameters.

Speaking of those configuration parameters reminds me of the Closed-Apple-Control-Reset. On a //e or //c, this does a self test. On the //gs it enters a menu-driven system-configuration program. You can set the time of day and the date, define the serial ports, allocate the slots, pick the screen colors, and so on. It is all done with just the four arrow keys, RETURN, and ESCAPE. Very nice! By the way, on a REAL IIgs, there is no closed-Apple key. Instead, there is an "option" key, between the case-lock and the open-Apple keys.

Yes, there are seven I/O slots, just like in the //e. Most cards that you now have in a II, II+, or //e will work in the //gs. However, not all. For example, Phil Wershba told me the quikLoader does not work. Not surprising, since the quikLoade tries to take control of the bus after a reset. The slots will probably not be used much, at least for a while, since so much I/O is already built-in. The IIgs comes already equipped with a clock/calendar, two serial ports (printer and modem, or two printers, or printer and AppleTalk, or whatever), disk controller (called the SmartPort, for up to six drives, mixing 3.5 and 5.25 sizes), music/speech synthesizer, RGB video, and the FrontDesk Bus (more on this later). I can see only one serious omission here, a SCSI port; Apple is supposedly offering a card for that purpose, so there goes one slot. In

my work I use things like the PromGramer to burn EPROMs, and a custom-made EPROM-emulator, and I frequently am testing new boards, so I need two or three more of the slots.

There is a catch here. Most of the built-in I/O ports have to be allocated a slot, even though they are really on the mother-board. Slot 1 is either a built-in serial port, or your card. Slot 2 is the other serial port, or your card. Slot 3 is the built-in text display, or your card. Slot 4 is the Mouse port, or your card. Slot 5 is the SmartPort, or your card. Slot 6 is the built-in disk port, or your card. Slot 7 is the built-in AppleTalk port, or your card. It all appears very rigid. I presume we will have to find ways to use the slots both ways at once, with tricky hardware and tricky software.

By the way, the game port is still there. There is an external 9-pin jack like on the //c, and an internal 16-pin socket like all the other members of the II-family. On the other hand, the cassette I/O is gone.

The FrontDesk Bus is a low-speed serial port to which the key-board and the mouse are attached. Various sources say a total of from 4 to 16 devices can be connected to this bus, including such items as trackballs, graphics tablets, and so on. The FrontDesk Bus has its own computer, a Mitsubishi 50740. The 50740 is a complete microcontroller based on the 6502, with opcode enhancements completely different from those in the 65C02 and 65816. I described it in the February 1986 AAL.

The various reports in other magazines and newspapers say that Apple will be selling a SCSI controller card and a 20-Megabyte hard disk. Some claim the hard disk will be partitionable so it can be shared by several operating systems on the IIgs, and also be shared by a Macintosh. For some reason I am a little skeptical about this one. In any case, whether Apple has one or not, I am certain that several 3rd-party drive sellers will. I expect a Sider, and I expect something from those who make SCSI-based Macintosh drives now. I haven't tried plugging my Sider into a IIgs slot yet; I am afraid. If it doesn't work, it could still wreak havoc (remember Murphy's law).

Everyone is talking about the new graphics and sound features. Apple encourages this by naming it "GS", which is supposed to mean Graphics and Sound. (I think it means "GaSsee", or "Gassee & Sculley".) If you hook it up to an RGB monitor, you get greatly enhanced grpahics capability. If you have only a normal NTSC color monitor, or a monochrome monitor, or a TV set with a modulator, you will only get standard Apple II graphics. The new feature I like best is the ability to choose colors for normal text displays: you choose the text color, the back-ground color, and the border color. The new feature most liked by the magazines, and all you graphics buffs, is the super hi-res graphics. You can display 200 lines, with either 320 pixels/line or 640 pixels/line. Each pixel has either two bits (640/line) or four bits (320/line). The pixel's value selects a color-entry from a palette. There are 4096 different colors available, of which up to 256 may be used on one screen. Any one line can display up to 16 different colors. With a hi-res

character generator in firmware, you can display multi-colored 80-column text mixed with graphics in the 640-pixel mode.

The IIgs includes a lot of firmware, well beyond the normal monitor, Applesoft, and I/O drivers. There is also a mini-assembler and a disassembler supporting the entire 65816 instruction set. The ToolBox ROM includes graphics routines and all the stuff you find in a Macintosh toolbox. Many Macintosh-based products will probably be translated to the IIgs, like Filevision. And then they can add color, too! Electronic Arts Inc. announced a color graphics tool for creation, editing, and animation. Is that the same as Paintworks? Anyway, have you played with Paintworks? Wow!

The IIgs still has the single-bit speaker-toggling sound generator, so your old programs can still make noises, though they might sound different because of the faster speed of the processor. But that is like saying that the latest Mercedes still has a steering wheel. There is a lot more! The Ensoniq synthesizer can play 15 simultaneous channels, with each one's voice defined by actual waveform data stored in a dedicated 64Kbyte RAM. Appropriate software makes it talk, better than any computers you ever heard before. Other soft- ware makes REAL music. The Ensoniq chip was designed for and is used in professional music synthesizers. It can also be used to sample actual sounds, to create your own synthetic instruments.

How fast is the IIgs? Well, it is faster than a //e, but slower than a //e with an accelerator card like Transwarp. The system clock runs at 2.8 MHz, but the processor slows down when writing "slow RAM" and when accessing I/O addresses. Memory refresh in fast RAM is done by using the internal refresh capability of the RAM chips triggered by reversed RAS and CAS signals. Whenever possible, these cycles are done without slowing down the processor: during a ROM read cycle, and during a cycle in which no memory access takes place. But if that were the only times, someone could put a JMP $800 at $800 and wipe out all the RAM! Therefore some more cycles are stolen periodically for refresh. The net result is that the processor runs closer to an average of 2.5 million cycles per second. The Transwarp, on the other hand, runs at 3.58 MHz whenever it can, so the //e so-equipped can outrun a IIgs. So far. But I will not be surprised if Applied Engineering, Checkmate Technology, or some other group comes out with an accelerator for the IIgs. Simply going up to 3.58 MHz would not be significant. But how about 7 MHz? Western Design Center plans to make 8 MHz chips someday, so....

The expanded instruction set in the 65816 makes it possible to write code that takes fewer cycles than an equivalent program in the 6502 or even 65C02. However, that advantage is probably offset by the additional overhead of accessing memory beyond 64K (because it takes an extra byte for the long addresses). There is also extra overhead in the firmware and in the operating system to handle the extra space and all the other new features.

Applied Engineering has already announced two different RAM

expansion cards for the IIgs. GS-RAM can grow to 1.5M. GS-RAM Plus can grow to 6M, or to 8M with an optional piggy-back card. A newcomer, MDIdeas, has announced a card called OctoRam, which can support from 256K to 8M expansion RAM. Apple themselves offer a 1M card. AST also has a 1 Mbyte card. Orange Micro has one which can grow from 512K to 4M.

MDIdeas also announced a $130 combination cooling fan and surge-supressing power strip, and a $60 sound boosting amplifer which splits the Ensoniq's output into left and right stereo channels. AST claims a new board called Vision Plus which can digitize black and white pictures. Orange Micro has an updated printer interface called the ProGrappler, with lots of graphic-handling firmware.

A salesman in our local Heath/Zenith store (they are now Apple dealers) asked me what kind of printers might be on the horizon for printing the IIgs color graphics. I wonder. Could someone figure out a way to connect a color Xerox machine to a personal computer? For under $5000? Polaroid might be a less expensive approach, just taking a photograph of the screen.

I am planning to buy a IIgs. How will I use it? I see it as a whole new world to explore, orders-of-magnitude larger in every dimension than was my 1977-vintage Apple II. I also see it as a software development engine, with the 65816 and gobs of RAM allowing much bigger projects to be tackled. Once the software tools are available, we should see lots of new applications.

Convert Hi-Res Pictures to Double Hi-Res.....David C. Johnson

I had a normal hi-res picture that I wanted to animate using the greater resolution of double hi-res. It was a monochrome picture (that is, it looked best when viewed on a monochrome monitor), but SOME of the bytes had the color bit set. This moved their 7 pixels over half position. If the color bit of the previous byte was NOT set, then its last bit extends into the half pixel left by the shifted byte. At the other end of a shifted byte, if the subsequent byte is UNSHIFTED, the shifted byte's last pixel is only half width.

One interesting sourec of monochrome pictures with some color bits on is the Apple Hi-Res Character Generator. Some of the character sets used by HRCG use shifted bytes for prettier slopes on letters like "A". Of course you never know what kind of bytes you may find after using a fancy picture-drawing program.

The following program performs a "perfect" translation, assuming a monochrome image. I also wrote a color converter, but it is not so "perfect". (I don't think a perfect color conversion is possible.)

My program assumes the picture to be converted is already in hi-res page 1, from $2000 through $3FFF. The pixels are shuffled around so that each original byte forms two bytes, one in main RAM and the other in auxiliary RAM. When the translation is done, a tone will beep at you until you type any key. Then I switch the double hi-res graphics on, and again beep until you hit any key. When you tire either of the beep or of viewing the double hi-res picture, type any key and it will stop. Text mode will be restored. I also copy the auxiliary half of the picture into main RAM at $4000 through $5FFF, and prepare it for being saved as a "foto-file".

I do the translation of a byte-ful of pixels into two double hi-res bytes by table lookup. The tables are generated by a subroutine in lines 2230-2480. You can make some interesting variations by changing either line 2310 or line 2340 (or both) from "ROL" to "ASL" instructions.

The subroutine in lines 2500-2670 waits for any key to be typed, while making an annoying beep. (Blame this one on Bob S-C, he wrote it.)

```
                1000 *SAVE HIRES.2.DBLHIRES
                1010 *-------------------------------
00-             1020 PTR1               .EQ $00,01
02-             1030 PTR2               .EQ $02,03
04-             1040 BIT6.AS.LSB        .EQ $04
                1050 *-------------------------------
2000-           1060 PAGE.1             .EQ $2000 - 3FFF
4000-           1070 PAGE.2             .EQ $4000 - 5FFF
                1080 *-------------------------------
C000-           1090 KEYBOARD           .EQ $C000
C010-           1100 STROBE             .EQ $C010
C030-           1110 SPEAKER            .EQ $C030
                1120 *-------------------------------
```

```
C000-                1130 STORE.80.OFF        .EQ $C000
C001-                1140 STORE.80.ON         .EQ $C001
C00C-                1150 COLUMN.80.OFF       .EQ $C00C
C00D-                1160 COLUMN.80.ON        .EQ $C00D
C01F-                1170 READ.COLUMN.80      .EQ $C01F
C050-                1180 GRAPHICS.ON         .EQ $C050
C051-                1190 GRAPHICS.OFF        .EQ $C051
C052-                1200 MIXED.OFF           .EQ $C052
C054-                1210 MAIN.PAGE           .EQ $C054
C055-                1220 AUX.PAGE            .EQ $C055
C057-                1230 HIRES.GRAPHICS      .EQ $C057
C05E-                1240 AN3.OFF             .EQ $C05E
C05F-                1250 AN3.ON              .EQ $C05F
C07E-                1260 IOU.DIS.ON          .EQ $C07E
                     1270 *-------------------------------
                     1280 DAVID.C.JOHNSON
0800- 20 BB 08       1290        JSR GEN.XLATE.MONO.TABLES
0803- 8E 7E C0       1300        STX IOU.DIS.ON
                     1310 *---Set up the screen mode-------
0806- AD 1F C0       1320        LDA READ.COLUMN.80   REMEMBER 40/80 STATE
0809- 48             1330        PHA
080A- 8D 01 C0       1340        STA STORE.80.ON
080D- 2C 54 C0       1350        BIT MAIN.PAGE        VIEW AS REGULAR HI-RES
0810- 2C 57 C0       1360        BIT HIRES.GRAPHICS
0813- 2C 52 C0       1370        BIT MIXED.OFF        FULL 192 LINES
0816- 8D 5F C0       1380        STA AN3.ON           (DOUBLE HI-RES OFF)
0819- 2C 50 C0       1390        BIT GRAPHICS.ON
                     1400 *---Build pointer----------------
081C- A9 20          1410        LDA /PAGE.1
081E- 85 01          1420        STA PTR1+1
0820- A0 00          1430        LDY #0
0822- 84 00          1440        STY PTR1
                     1450 *---Process six lines of pixels---
0824- A9 00          1460 .1     LDA #0               CLEAR BIT6 FLAG
0826- 85 04          1470        STA BIT6.AS.LSB
0828- B1 00          1480 .2     LDA (PTR1),Y
082A- AA             1490        TAX                  SAVE BYTE OF PIXELS
082B- 10 04          1500        BPL .3               ...NO HALF-PIXEL HERE
082D- A5 04          1510        LDA BIT6.AS.LSB      GET PREVIOUS BIT6
082F- 10 02          1520        BPL .4               ...ALWAYS
0831- A9 00          1530 .3     LDA #0
0833- 2C 55 C0       1540 .4     BIT AUX.PAGE
0836- 1D 00 0A       1550        ORA XLATE.MONO.AUX,X
0839- 91 00          1560        STA (PTR1),Y
083B- 2C 54 C0       1570        BIT MAIN.PAGE
083E- BD 00 0B       1580        LDA XLATE.MONO.MAIN,X
0841- 91 00          1590        STA (PTR1),Y
0843- 8A             1600        TXA                  GET BYTE OF PIXELS
0844- 2A             1610        ROL                  FIND BIT 6
0845- 2A             1620        ROL
0846- A9 00          1630        LDA #0
0848- 2A             1640        ROL
0849- 85 04          1650        STA BIT6.AS.LSB
084B- C8             1660        INY
084C- 98             1670        TYA
084D- 29 7F          1680        AND #$7F
084F- C9 28          1690        CMP #$28
0851- F0 D1          1700        BEQ .1          START A NEW LINE
0853- C9 50          1710        CMP #$50
0855- F0 CD          1720        BEQ .1          START A NEW LINE
0857- C9 78          1730        CMP #$78
0859- 90 CD          1740        BCC .2          ...IN SAME LINE
085B- 98             1750        TYA
085C- 69 07          1760        ADC #7          HOP OVER 8 BYTES
085E- A8             1770        TAY
085F- D0 C3          1780        BNE .1          START A NEW LINE
0861- E6 01          1790        INC PTR1+1      START A NEW 6-LINE GROUP
0863- A5 01          1800        LDA PTR1+1
0865- 29 1F          1810        AND #$1F
0867- D0 BB          1820        BNE .1          ...UNLESS END OF SCREEN
                     1830 *---View the results-------------
0869- 20 EC 08       1840        JSR WAIT.FOR.ANY.KEY
086C- 8D 0C C0       1850        STA COLUMN.80.OFF
086F- 8D 5E C0       1860        STA AN3.OFF  DOUBLE HIRES ON
0872- 8D 5F C0       1870        STA AN3.ON
0875- 8D 5E C0       1880        STA AN3.OFF
0878- 8D 5F C0       1890        STA AN3.ON
087B- 8D 0D C0       1900        STA COLUMN.80.ON
087E- 8D 5E C0       1910        STA AN3.OFF
0881- 20 EC 08       1920        JSR WAIT.FOR.ANY.KEY
```

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Expand the IIGS RAM and ROM with the GSRAM or GSRAM Plus with ROM Pak. Available now with 256K to 8 MEG!

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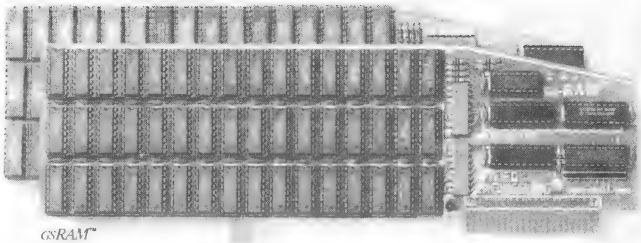

GSRAM™

Remember the 16K cards for the II+ and the 64K cards for the IIe? At the time, that much memory seemed like a lot. But when the owners of these memory cards came to us for more memory, many had to throw away their smaller Apple memory cards or try to sell them. Most of our customers told us that had they known about Applied Engineering's larger memory cards when they bought their Apple, they would have purchased them at the same time.

GSRAM and GSRAM Plus are available now, allowing up to 8 MEG of memory expansion. That's 8 times the memory capacity of Apple's card and just look at the benefits that only GSRAM and GSRAM Plus have over Apple's card:

- Lower cost
- Has 6 RAM banks (Apple's card has 4)
- Has memory expansion port
- Has ROM expansion port
- No configuration blocks to set
- No soldered in RAM chips
- Expandable to 8 MEG
- Expands AppleWorks internal limits
- Built-in Hi-Res self-diagnostic software
- 5 year hassle free warranty (Apple has a 90 day warranty)
- Made in USA

GSRAM for More AppleWorks Power

Only GSRAM and GSRAM Plus eliminates AppleWorks internal memory limits, increasing the maximum number of records available from 6,000 to over 25,000 and only GSRAM and GSRAM Plus increases the number of lines permitted in the word processing mode from 6,000 to over 15,000. And only GSRAM and GSRAM Plus offers a built-in printer buffer so you can continue using AppleWorks while your printer is printing. GSRAM and GSRAM Plus even expand the number of lines in the dipboard from 255 to 2047 and will auto segment large files so they can be saved on two or more disks. You can even have Pinpoint or Macroworks and your favorite spelling checker in RAM for instant response. GSRAM and GSRAM Plus will even display the time and date right on the AppleWorks screen. Nothing comes close to enhancing AppleWorks so much.

Turn Your IIGS into a Giant

Simply plug GSRAM into the IIGS memory expansion slot and you've got up to *8 megabytes* of RAM at your fingertips—all of it instantly and automatically recognized by the IIGS. GSRAM is compatible with all IIGS software, including AppleWorks, as well as BASIC®, ProDos, DOS 3.3, PASCAL®, "C" and CP/M®.

Grow by Bytes or Megabytes

We offer GSRAM in two configurations so you can increase your memory 256K at a time (GSRAM) or a megabyte at a time (GSRAM Plus). Both offer full compatibility, lower cost than other boards, and easy expandability. And both are extremely low in power consumption. A fully expanded GSRAM operates at only 375 ma, and GSRAM Plus at only 270 ma (even with 6 megabytes on board!)

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GSRAM is available with 256K, 512K, 1 MEG or 1.5 MEG of memory already on board. If you don't need the full 1.5 MEG now, you can choose a GSRAM with less memory and expand it up to 1.5 MEG in the future—or upgrade to GSRAM Plus for a small charge.

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Steve Wozniak, the creator of Apple Computer

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GSRAM Plus is the first Apple memory card to use 1 MEG RAM chips on the main board. It's available with 1 to 6 MEG on board. If you don't need the whole 6 MEG now, you can buy a GSRAM Plus with less memory and easily expand it in the future.

GSRAM Plus can be expanded up to 8 MEG with an optional piggyback card.

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Quality and Support of the Industry Leader

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GSRAM with 256K	**$169**
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GSRAM with 2-8 MEG	**CALL**
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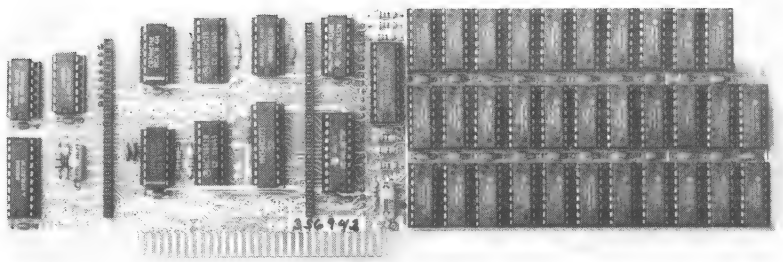
RamWorks® III

Patented Performance from the Recognized Leader



With battery backed RAM port, RGB port, increased memory capacity, full software compatibility and more compact design, RamWorks III is a generation ahead.

RamWorks III is the newest 3rd generation RAM card for the Apple IIe. It incorporates all of the technology and improvements that years of experience and over a hundred thousand sales have given us. By selling more memory cards than anyone else and listening to our customers, we were able to design a memory card that has the ultimate in performance, quality, compatibility and ease of use. A design so advanced it's patented. We call it RamWorks III, you'll call it awesome!

The AppleWorks Amplifier.

While RamWorks III is recognized by all memory intensive programs, NO other expansion card comes close to offering the multitude of enhancements to AppleWorks that RamWorks III does. Naturally, you'd expect RamWorks III to expand the available desktop, after all Applied Engineering was a year ahead of everyone else *including Apple* in offering more than 55K, and we still provide the largest AppleWorks desktops available. But a larger desktop is just part of the story. Look at all the AppleWorks enhancements that even Apple's own card does not provide and *only* RamWorks III does. With a 256K or larger RamWorks III, *all* of AppleWorks (including printer routines) will automatically load itself into RAM dramatically increasing speed by eliminating the time required to access the program disk drive. Switch from word processing to spreadsheet to database at the speed of light with no wear on disk drives.

Only RamWorks eliminates AppleWorks' internal memory limits, increasing the maximum number of records available from 1,350 to over 25,000. *Only* RamWorks increases the number of lines permitted in the word processing mode from 2,250 to over 15,000. And *only* RamWorks offers a built-in printer buffer, so you won't have to wait for your printer to stop before returning to AppleWorks. RamWorks even expands the clipboard. And auto segments large files so they can be saved on two or more disks. You can even have Pinpoint or MacroWorks and your favorite spelling checker in RAM for instant response.

RamWorks, nothing comes close to enhancing AppleWorks so much.

The Most Friendly, Most Compatible Card Available.

Using RamWorks III couldn't be easier because it's compatible with more off-the-shelf software than any other RAM card. Popular programs like AppleWorks, Pinpoint, Catalyst, MouseDesk, Howard-Soft, FlashCalc, Pro-Filer, Managing Your Money, SuperCalc 3a, and MagiCalc to name a few (and *all* hardware add on's like ProFile and Sider hard disks). RamWorks is even compatible with software written for Apple cards. But unlike other cards, RamWorks plugs into the IIe auxiliary slot providing our super sharp 80 column text (U.S. Patent #4601081) in a completely integrated system while leaving expansion slots 1 through 7 available for other peripheral cards.

RamWorks III is compatible with all Apple IIe's, enhanced, unenhanced, American or European versions.

Highest Memory Expansion.

Applied Engineering has always offered the largest memory for the IIe and RamWorks III continues that tradition by expanding to 1 full MEG on the main card using standard RAMs, more than most will ever need (1 meg is about 500 pages of text)...but if you do ever need more than 1 MEG, RamWorks III has the widest selection of expander cards available. Additional 512K, 2 MEG, or 16 MEG cards just snap directly onto RamWorks III by plugging into the industry's only low profile (no slot 1 interference) fully decoded memory expansion connector. You can also choose non-volatile, power independent expanders allowing permanent storage for up to 20 years.

It Even Corrects Mistakes.

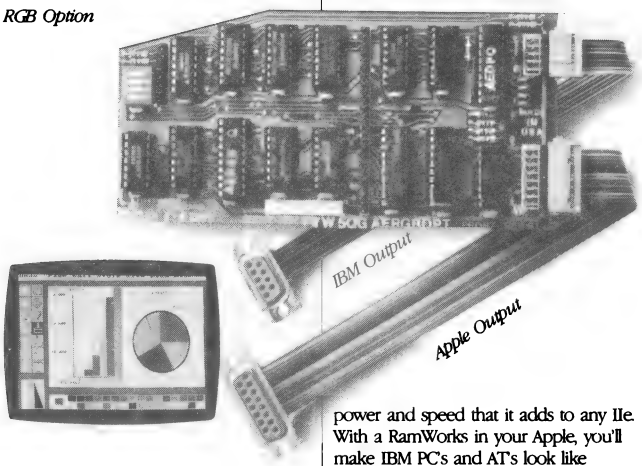
If you've got some other RAM card that's not being recognized by your programs, and you want RamWorks III, you're in luck. Because all you have to do is plug the memory chips from your current card into the expansion sockets on RamWorks to recapture most of your investment!

The Ultimate in RGB Color.

RGB color is an option on RamWorks and with good reason. Some others combine RGB color output with their memory cards, but that's unfair for those who don't need RGB *and* for those that do. Because if you don't need RGB

Applied Engineering doesn't make you buy it, but if you want RGB output you're in for a nice surprise because the RamWorks RGB option offers better color graphics plus a more readable 80 column text (that blows away any composite color monitor). For only $129 it can be added to RamWorks giving you a razor sharp, vivid brilliance that most claim is the best they have ever seen. You'll also appreciate the multiple text colors (others only have green) that come standard. But the RamWorks RGB option is more than just the ultimate in color output because unlike others, it's fully compatible with all the Apple standards for RGB output control, making it more compatible with off-the-shelf software. With its FCC certified design, you can use almost any RGB monitor because only the new RamWorks RGB option provides both Apple standard and IBM standard RGB outputs (cables included). The RGB option plugs into the back of RamWorks with no slot 1 interference and remember you can order the RGB option with your RamWorks or add it on at a later date.

RGB Option



True 65C816 16 Bit Power.

RamWorks III has a built-in 65C816 CPU port for direct connection to our optional 65C816 card. The only one capable of linearly addressing more than 1 meg of memory for power applications like running the Lotus 1-2-3™ compatible program, VIP Professional. Our 65C816 card does not use another slot but replaces the 65C02 yet maintains full 8 bit compatibility.

Endorsed by the Experts.

A+ magazine said "Applied Engineering's RamWorks is a boon to those who must use large files with AppleWorks...I like the product so much that I am buying one for my own system." inCider magazine said "RamWorks is the most powerful auxiliary slot memory card available for your IIe, and I rate it four stars...For my money, Applied Engineering's RamWorks is king of the hill."

"I wanted a memory card for my Apple that was fast, easy to use, and very compatible; so I bought RamWorks."

Steve Wozniak, the creator of Apple Computer

Apple experts everywhere are impressed by RamWorks's expandability, versatility, ease of use, and the sheer power and speed that it adds to any IIe. With a RamWorks in your Apple, you'll make IBM PC's and AT's look like slowpokes.

Quality and Support of the Industry Leader

RamWorks III is from Applied Engineering, the largest, most well supported manufacturer of Apple peripherals and the inventor of large RAM cards for the Apple. With our 5 year no hassle warranty and outstanding technical support, you're assured of the most trouble free product you can buy.

It's Got It All

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- Expandable to 1 MEG on main card
- Expandable to 16 meg with expander cards, with NO slot 1 interference
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- Powerful linear addressing 16 bit coprocessor port
- Automatic AppleWorks expansion up to 3017K desktop
- Accelerates AppleWorks
- Built-in AppleWorks printer buffer
- The only large RAM card that's 100% compatible with all IIe software
- RamDrive™ the ultimate disk emulation software included free
- Memory is easily partitioned allowing many programs in memory at once
- Compatible, RGB option featuring ultra high resolution color graphics and multiple text colors, with cables for both Apple and IBM type monitors
- Built-in self diagnostics software
- Lowest power consumption (U.S. Patent #4601081)
- Takes only one slot (auxiliary) even when fully expanded
- Socketed and user upgradeable
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- Used by Apple Computer, Steve Wozniak and virtually all software companies
- Displays date and time on the AppleWorks screen with any PRO-DOS compatible clock
- Much, much more!

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RGB Option	**$129**
Optional Software:	
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```
0884- 84 02     1930         STY PTR2
0886- A2 40     1940         LDX /PAGE.2
0888- 86 03     1950         STX PTR2+1
088A- A9 20     1960         LDA /PAGE.1
088C- 86 01     1970         STX PTR1+1
                1980 *-------------------------------
                1990 *   Setup for BSAVE:     After BLOAD:
088E- B1 00     2000 .6      LDA (PTR1),Y      lda (ptr1),y
0890- 91 02     2010         STA (PTR2),Y      bit aux.page
0892- 2C 55 C0  2020         BIT AUX.PAGE      sta (ptr1),y
0895- B1 00     2030         LDA (PTR1),Y      lda (ptr2),y
0897- 2C 54 C0  2040         BIT MAIN.PAGE     bit main.page
089A- 91 00     2050         STA (PTR1),Y      sta (ptr1),y
089C- C8        2060         INY
089D- D0 EF     2070         BNE .6
089F- E6 01     2080         INC PTR1+1
08A1- E6 03     2090         INC PTR2+1
08A3- CA        2100         DEX
08A4- D0 E8     2110         BNE .6
08A6- A9 03     2120         LDA #$03     (/PIXEL) MARK AS DBLHIRES
08A8- 8D 78 20  2130         STA PAGE.1+$78              FOTO-FILE
                2140 *-------------------------------
08AB- 8D 5F C0  2150         STA AN3.ON
08AE- 2C 51 C0  2160         BIT GRAPHICS.OFF
08B1- 68        2170         PLA          RESTORE 40/80 STATE
08B2- 30 06     2180         BMI .7
08B4- 8D 00 C0  2190         STA STORE.80.OFF
08B7- 8D 0C C0  2200         STA COLUMN.80.OFF
08BA- 60        2210 .7      RTS
                2220 *-------------------------------
                2230 *-------------------------------
                2240 GEN.XLATE.MONO.TABLES
08BB- A2 00     2250         LDX #0
08BD- A0 07     2260 .1      LDY #7
08BF- 8A        2270         TXA
08C0- 0A        2280         ASL
08C1- 0A        2290 .2      ASL
08C2- 08        2300         PHP
08C3- 3E 00 0A  2310         ROL XLATE.MONO.AUX,X
08C6- 3E 00 0B  2320         ROL XLATE.MONO.MAIN,X
08C9- 28        2330         PLP
08CA- 3E 00 0A  2340         ROL XLATE.MONO.AUX,X
08CD- 3E 00 0B  2350         ROL XLATE.MONO.MAIN,X
08D0- 88        2360         DEY
08D1- D0 EE     2370         BNE .2
08D3- 8A        2380         TXA
08D4- 10 06     2390         BPL .3
08D6- 1E 00 0A  2400         ASL XLATE.MONO.AUX,X
08D9- 3E 00 0B  2410         ROL XLATE.MONO.MAIN,X
08DC- 1E 00 0A  2420 .3      ASL XLATE.MONO.AUX,X
08DF- 3E 00 0B  2430         ROL XLATE.MONO.MAIN,X
08E2- 1E 00 0B  2440         ASL XLATE.MONO.MAIN,X
08E5- 5E 00 0B  2450         LSR XLATE.MONO.MAIN,X
08E8- E8        2460         INX
08E9- D0 D2     2470         BNE .1
08EB- 60        2480         RTS
                2490 *-------------------------------
                2500 WAIT.FOR.ANY.KEY
08EC- A0 00     2510         LDY #0
08EE- AD 30 C0  2520 .1      LDA SPEAKER
08F1- CA        2530 .2      DEX
08F2- D0 FD     2540         BNE .2
08F4- 2C 00 C0  2550         BIT KEYBOARD
08F7- 30 05     2560         BMI .3       GOT A KEY
08F9- 88        2570         DEY
08FA- 10 F2     2580         BPL .1
08FC- 30 F3     2590         BMI .2
08FE- 8D 10 C0  2600 .3      STA STROBE
0901- 60        2610         RTS
                2620 *-------------------------------
0902-           2630         .BS *+255/256*256-*
                2640 *-------------------------------
0A00-           2650 XLATE.MONO.AUX      .BS 256
0B00-           2660 XLATE.MONO.MAIN     .BS 256
                2670 *-------------------------------
```

Moore Screen Tricks.....Robert C. Moore

Here are two short routines that are easy to understand. The problem is this: what do they do? I think you readers will enjoy the challenge of finding out!

```
                    1000 *SAVE S.MOORE'S CHALLENGE
                    1010 *-------------------------------
25-                 1020 MON.CV .EQ $25
28-                 1030 BAS    .EQ $28,29
FC22-               1040 MON.VTAB           .EQ $FC22
FDED-               1050 COUT               .EQ $FDED
                    1060 *-------------------------------
                    1070        .OR $300
                    1080 *-------------------------------
0300- A0 27         1090 SUB1   LDY #39       For Y = 39 to 0
0302- B1 28         1100 .1     LDA (BAS),Y
0304- 49 E0         1110        EOR #$E0
0306- 18            1120        CLC
0307- 69 E0         1130        ADC #$E0
0309- 91 28         1140        STA (BAS),Y
030B- 88            1150        DEY
030C- 10 F4         1160        BPL .1
030E- 60            1170        RTS
                    1180 *-------------------------------
030F- A0 27         1190 SUB2   LDY #39       For Y = 39 to 0
0311- B1 28         1200 .1     LDA (BAS),Y
0313- 4A            1210        LSR
0314- 4A            1220        LSR
0315- 4A            1230        LSR
0316- 4A            1240        LSR
0317- 4A            1250        LSR
0318- AA            1260        TAX
0319- BD 24 03      1270        LDA TABLE,X
031C- 51 28         1280        EOR (BAS),Y
031E- 91 28         1290        STA (BAS),Y
0320- 88            1300        DEY
0321- 10 EE         1310        BPL .1
0323- 60            1320        RTS
                    1330 *-------------------------------
0324- C0 80 00
0327- 80 00 80
032A- C0 80         1340 TABLE  .HS C0.80.00.80.00.80.C0.80
                    1350 *-------------------------------
```

Here is a little Applesoft routine that may be used to exercise either SUB1 or SUB2. Change line 120 as indicated to select which subroutine will be used.

```
 10  PRINT  CHR$ (4)"PR#3"
 20  PRINT  CHR$ (17); : REM Set to 40-column
 30  PRINT  CHR$ (12); : REM HOME and clear
 40  PRINT  CHR$ (27); : REM Turn on MouseText
 50  GOSUB 200 : REM Lines 1 to 6
 60  PRINT
 70  GOSUB 200 : REM Lines 8 to 13
 80  PRINT  CHR$ (24); : REM Filter out MouseText
 90  GOSUB 200 : REM Lines 15 to 20

100  FOR V = 1 TO 6
110  VTAB V
120  CALL 768 : REM 768=SUB1 or 783=SUB2
130  FOR I = 0 TO 999: NEXT
140  NEXT
150  GO TO 100
```

```
200  FLASH   : GOSUB 300
210  INVERSE : GOSUB 300
220  NORMAL  : GOSUB 300
230  RETURN

300  PRINT "0123456789 ABCDEFGHIJKLMNOPQRSTUVWXYZ"
310  PRINT "0123456789 abcdefghijklmnopqrstuvwxyz"
320  RETURN
```

The following little Applesoft subroutine will put every possible value on the screen, in eight lines of 32 characters each. You might try running SUB1 and SUB2 with this information on the screen, too.

```
500  REM Put every value on screen
510  FOR V = 0 TO 7 : VTAB V + 1
520  A = PEEK (40) + PEEK (41) * 256
530  FOR H = 0 TO 31
540  POKE A + H, V * 32 + H
550  NEXT : NEXT : RETURN
```

Text Window Inverter.....Bob Sander-Cederlof

Bob Moore's challenge prompted me to construct the following useful utility. This program lets you set up a table of screen windows, and then invert whatever is in any particular window at will.

The window table consists of a list of window descriptors. Each window descriptor is four bytes, giving the top line, the bottom line, the leftmost character, and the rightmost character. For example, a full-screen window would be 0, 23, 0, 39. My program as given handles only the 40-column screen. It would be a relatively minor modification to change it to handle the 80-column screen.

The routine can be thought of in two steps. The first problem is how to scan through every character inside the window. I do this with a pair of nested loops. The outer loop scans from line to line, and the inner loop scans the characters within a line. The second problem is how to "invert" a character.

After studying the Apple screen character set, I decided to do everything with MouseText switched on. This gives me inverse lower-case letters, which are not available when MouseText is switched off. I came up with the following inversion rules:

Current Value	Inverted Value	EOR Value
$A0...BF	$20...3F	$80
$C0...DF	$00. .1F	$C0
$E0...FF	$60...7F	$80

Values in the ranges $40...5F and $80...9F should not be changed, as doing so would make nonsense on the screen.

All of the changes can be made by using an EOR opcode with the proper mask. Bob Moore put these values in a table, but I did not want to use the X-register to index into a table, because I already was using it to slect which window I was using. Therefore I figured out a scheme that COMPUTES the proper EOR value. You can see it in lines 1120-1210 of the program.

Lines 1350-1530 are a sample driver, to let you play with the capabilities of the Window Inverter subroutine. Lines 1360-1370 print a control-Q to select the 40-column mode of Apple 80-column firmware. Line 1380 turns on the MouseText character set. Lines 1390-1410 wait until you type a key on the keyboard. If the key is <RETURN>, lines 1420-1460 will restore to 80-column mode and quit. Otherwise, the low-order three bits are used as an index to pick one of eight windows I set up in lines 1540-1620. (These are just sample windows, varying from one character to the whole screen.) It is fun to run this sample program, and then just type any sentence or data. The screen gets flipped every-which-a-way as you type.

A subroutine like this does have practical value. A long time ago I used one in a special program I wrote for the American Heart Association. The program ws menu-driven, but there was no keyboard! The user held a lightpen, and pointed it at the menu selection he wanted. The menu was arranged in a matrix, with varying numbers of items. One time it might be nine items, arranged like a tic-tac-toe matrix. Another time it might be two rows of four each, and so on. Whatever item the lightpen was pointing at would be displayed in inverse, while all the others were in normal mode. A switch on the pen barrel told the computer to go with the "high-lighted" selection.

```
                    1000 *SAVE S.WINDOW INVERTER
                    1010 *-------------------------------
25-                 1020 MON.CV     .EQ $25
28-                 1030 BAS        .EQ $28,29
                    1033 *-------------------------------
FC22-               1040 MON.VTAB   .EQ $FC22
FDED-               1050 COUT       .EQ $FDED
                    1060 *-------------------------------
                    1070 WINDOW.INVERT.40
0800- BD 59 08      1080         LDA WINDOWS,X      Y-TOP
0803- 85 25         1090         STA MON.CV
0805- 20 22 FC      1100 .1      JSR MON.VTAB
0808- BC 5B 08      1110         LDY WINDOWS+2,X    X-LEFT
080B- B1 28         1120 .2      LDA (BAS),Y
080D- 0A            1130         ASL
080E- B0 08         1140         BCS .4
0810- 30 08         1150         BMI .5
0812- 09 BF         1160 .3      ORA #$BF
0814- 49 7F         1170         EOR #$7F
0816- 30 05         1180         BMI .6         ...ALWAYS
0818- 30 F8         1190 .4      BMI .3
081A- 0A            1200 .5      ASL
081B- 29 80         1210         AND #$80
081D- 51 28         1220 .6      EOR (BAS),Y
081F- 91 28         1230         STA (BAS),Y
0821- 98            1240         TYA
0822- C8            1250         INY
0823- DD 5C 08      1260         CMP WINDOWS+3,X    X-RIGHT
0826- 90 E3         1270         BCC .2
0828- A5 25         1280         LDA MON.CV
082A- E6 25         1290         INC MON.CV
082C- DD 5A 08      1300         CMP WINDOWS+1,X    Y-BOTTOM
082F- 90 D4         1310         BCC .1
0831- C6 25         1320         DEC MON.CV
0833- 60            1330         RTS
                    1340 *-------------------------------
```

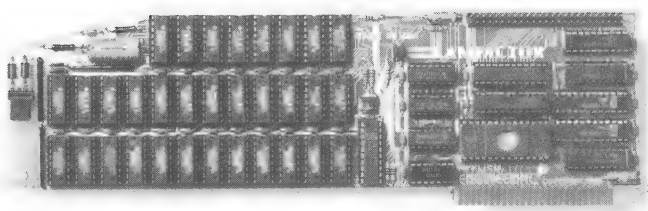
```
                        1350 T
0834- A9 91             1360          LDA #"Q"-$40
0836- 20 ED FD          1370          JSR COUT
0839- 8D 0F C0          1380          STA $C00F     SELECT MOUSE TEXT
083C- AD 00 C0          1390 .1       LDA $C000
083F- 10 FB             1400          BPL .1
0841- 8D 10 C0          1410          STA $C010
0844- C9 8D             1420          CMP #$8D
0846- D0 06             1430          BNE .2
0848- A9 92             1440          LDA #"R"-$40
084A- 20 ED FD          1450          JSR COUT
084D- 60                1460          RTS
084E- 29 07             1470 .2       AND #7
0850- 0A                1480          ASL
0851- 0A                1490          ASL
0852- AA                1500          TAX
0853- 20 00 08          1510          JSR WINDOW.INVERT.40
0856- 4C 3C 08          1520          JMP .1
                        1530 *--------------------------------
                        1540 WINDOWS
0859- 00 17 00
085C- 27                1550          .DA #00,#23,#00,#39     FULL SCREEN
085D- 05 14 05
0860- 14                1560          .DA #05,#20,#05,#20
0861- 07 11 08
0864- 10                1570          .DA #07,#17,#08,#16
0865- 0F 16 0F
0868- 1E                1580          .DA #15,#22,#15,#30
0869- 00 0A 1E
086C- 27                1590          .DA #00,#10,#30,#39
086D- 04 06 20
0870- 24                1600          .DA #04,#06,#32,#36
0871- 0B 0D 13
0874- 15                1610          .DA #11,#13,#19,#21
0875- 0C 0C 14
0878- 14                1620          .DA #12,#12,#20,#20
                        1630 *--------------------------------
```

RamFactor™

All the Performance, Speed, and Software Compatibility of RamWorks™ in a Slot 1 through 7 Card.

That's right! Now Applied Engineering offers you a choice. While RamWorks is the clear winner for the auxiliary slot in a IIe, RamFactor is the standard for slots 1 through 7. Now anyone with an Apple II+, Franklin, or Apple IIe preferring to use slots 1 through 7 can now enjoy the speed and performance that until now was only available with RamWorks.

With RamFactor, you'll be able to instantly add another 256K, 512K, or a full 1 meg on the main board and up to 16 meg with additional piggyback card. And since virtually all software is automatically compatible with RamFactor, you'll immediately be able to load programs into RamFactor for instantaneous access to information. You'll also be able to store more data for larger word processing documents, bigger data bases, and expanded spreadsheets.



Very Compatible

All the leading software is already compatible with RamFactor. Programs like AppleWorks, Pinpoint, BPI, Managing Your Money, Dollars and Sense, SuperCalc 3A, PFS, MouseWrite, MouseDesk, MouseCalc, Sensible Speller, Applewriter IIe, Business Works, ReportWorks, Catalyst 3.0 and more. And RamFactor is fully ProDos, DOS 3.3, Pascal 1.3 and CP/M compatible. In fact, no other memory card (RamWorks excepted) is more compatible with commercial software.

AppleWorks Power

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Woz's Five-digit Math Puzzler

Ten years ago, before Woz was well-known or wealthy, he published a 5-digit "Mastermind" puzzle in Dr. Dobbs Journal (Sept 1976). The program was written in 6502 assembly language, naturally, and would work as printed in an Apple I. Not long ago I was looking through some back issues and came across it.

Being overcome by nostalgia, I just had to type it in and make it work in an Apple II. I added a few minor things, such as the ability to stop playing by typing a <RETURN>. (I also put in a secret way to "cheat", so you can impress your friends with your ability to beat the computer.)

Woz has always displayed a knack for getting the most out of every byte. In fact, the salesman who sold me my first Apple II back in 1977 convinced me with the remark, "I don't know how they got so much stuff in there!" The following program is yet another example. He used a lot of coding tricks, including some that were new to me. I am not going to point them all out, but you will enjoy going on a treasure hunt: look for negative indexing in page-zero arrays, automatic initialization of loops, and other sort-of-sneaky tricks. But keep looking, because there are some even-sneakier tricks! I didn't see some of them until I tried my hand at "improving" the code.

```
                        1000 *SAVE S.WOZNIAK
                        1010 *--------------------------------
                        1020 *   A Number Game for the 6502, by Steve Wozniak
                        1030 *   Published in Dr. Dobb's Journal, September 1976.
                        1040 *--------------------------------
                        1050 *   Adapted for the Apple II by Bob Sander-Cederlof
                        1060 *--------------------------------
C000-                   1070 KEYBOARD .EQ $C000
C010-                   1080 STROBE   .EQ $C010
                        1090 *--------------------------------
FD0C-                   1100 MON.RDKEY  .EQ $FD0C
FDDA-                   1110 MON.PRBYTE .EQ $FDDA
FD8E-                   1120 MON.CROUT  .EQ $FD8E
FDED-                   1130 MON.COUT   .EQ $FDED
                        1140 *--------------------------------
00-                     1150 TRIES  .EQ $00
03-                     1160 RND2L  .EQ $03
04-                     1170 N      .EQ $04 ...08
09-                     1180 GUESS  .EQ $09 ...0D
                        1190 *--------------------------------
4E-                     1200 RNDL   .EQ $4E
4F-                     1210 RNDH   .EQ $4F
                        1220 *--------------------------------
                        1230 T
                        1240 MSTMND
0800- A2 08             1250         LDX #Q.RDY   Print "READY?"
0802- BD 7D 08          1260 MSGLP   LDA MSG-1,X
0805- 20 ED FD          1270         JSR MON.COUT
0808- CA                1280         DEX
0809- D0 F7             1290         BNE MSGLP
                        1300 *---Clear TRY count--------------
080B- 86 00             1310         STX TRIES     X = 0
                        1320 *---Wait until player ready------
                        1330 *   Creates random number in RNDH,RNDL
080D- 20 0C FD          1340         JSR MON.RDKEY
0810- C9 8D             1350         cmp #$8D      Stop if <RETURN>
0812- D0 01             1360         bne NXTRY
0814- 60                1370         rts
                        1380 *---Count the try----------------
                        1390 *   (X-reg is 0 now)
0815- 38                1400 NXTRY   SEC
0816- F8                1410         SED
0817- 8A                1420         TXA           X=0
```

```
0818- 65 00     1430         ADC TRIES     Add 1 to tries in BCD mode
081A- 85 00     1440         STA TRIES
081C- D8        1450         CLD
                1460 *---Display the try count--------
081D- 20 8E FD  1470 NXTLIN  JSR MON.CROUT
0820- A5 00     1480         LDA TRIES     Print number of tries in BCD
0822- 20 DA FD  1490         JSR MON.PRBYTE
0825- A9 A0     1500         LDA #" "      BLANK
0827- A8        1510         TAY           $A0, bits 43210 all clear
0828- 20 ED FD  1520         JSR MON.COUT  Print the space
                1530 *---Build array of digits--------
082B- A5 4E     1540         LDA RNDL      Use the random number
082D- 85 03     1550         STA RND2L        without changing it
082F- A5 4F     1560         LDA RNDH      x5554443 11122233
                1570 *                     (Remember that Y-reg holds $A0)
0831- A2 05     1580         LDX #5        Do 5 digits
0833- 94 03     1590 .1      STY N-1,X     Be sure bits 43210 are clear
0835- A0 03     1600         LDY #3        Shift in next three bits from RND
0837- 4A        1610 .2      LSR
0838- 26 03     1620         ROL RND2L
083A- 36 03     1630         ROL N-1,X
083C- 88        1640         DEY
083D- D0 F8     1650         BNE .2        Next bit
083F- CA        1660         DEX
0840- D0 F1     1670         BNE .1        Next digit
                1680 *---Read player's guess----------
                1690 *   X- and Y-regs are 0 now
0842- 20 8F 08  1700         JSR GET.GUESS
0845- 90 D6     1710         BCC NXTLIN
                1720 *---Check digits in position-----
                1730 *   (X-reg is -5 now)
0847- A0 FB     1740         LDY #-5
0849- A9 A0     1750         LDA #" "      Print a space
084B- 20 ED FD  1760 .4      JSR MON.COUT    (or a "+")
084E- B5 0E     1770 .5      LDA GUESS+5,X
0850- D5 09     1780         CMP N+5,X
0852- D0 0D     1790         BNE .6           ...not an exact match
0854- 94 09     1800         STY N+5,X        ...matches, so clobber it
0856- A9 AB     1810         LDA #"+"           and print a "+"
0858- 95 0E     1820         STA GUESS+5,X    (clobber here too)
085A- C8        1830         INY           Count the +
085B- D0 EE     1840         BNE .4        ...not 5 yet, try another
085D- A2 11     1850         LDX #Q.WIN    All 5 correct!
085F- D0 A1     1860         BNE MSGLP     Say so, invite another game.
0861- E8        1870 .6      INX           Next digit position
0862- D0 EA     1880         BNE .5
                1890 *---Check for digits out of position---
0864- A0 FB     1900         LDY #-5       For each digit in guess...
0866- B6 0E     1910 .7      LDX GUESS+5,Y      (Cannot use LDA GUESS+5,Y
0868- 8A        1920         TXA                 because that would not wrap!)
0869- A2 FB     1930         LDX #-5          For each digit in puzzle...
086B- D5 09     1940 .8      CMP N+5,X
086D- D0 07     1950         BNE .9           ...different
086F- 94 09     1960         STY N+5,X        ...same, clobber in puzzle
0871- A9 AD     1970         LDA #"-"           and print a "-"
0873- 20 ED FD  1980         JSR MON.COUT
0876- E8        1990 .9      INX              Next puzzle digit
0877- D0 F2     2000         BNE .8
0879- C8        2010         INY           Next guess digit
087A- D0 EA     2020         BNE .7
087C- F0 97     2030         BEQ NXTRY     ...always, and X must = 0
                2040 *-------------------------------
087E- BF D9 C4
0881- C1 C5 D2  2050 MSG     .AS -/?YDAER/
0884- 8D        2060         .HS 8D
0885- 8D        2070         .HS 8D
08-             2080 Q.RDY   .EQ *-MSG
0886- CE C9 D7
0889- A0 D5 CF
088C- D9 A0 AB  2090         .AS -/NIW UOY +/
11-             2100 Q.WIN   .EQ *-MSG
                2110 *-------------------------------
                2120 GET.GUESS
088F- AD 00 C0  2130 .1      LDA KEYBOARD       Read char from keyboard
0892- 10 FB     2140         BPL .1
0894- 8D 10 C0  2150         STA STROBE         Clear the strobe
0897- C9 B8     2160         CMP #"8"           <My little secret!>
0899- D0 04     2170         BNE .2
089B- B5 08     2180         LDA N+4,X          <Cheat!>
089D- 09 B0     2190         ORA #"0"
```

```
089F- 20 ED FD 2200 .2     JSR MON.COUT       Echo the character
08A2- 49 B0    2210        EOR #"0"           Convert to binary if 0-7
08A4- C9 08    2220        CMP #8
08A6- B0 08    2230        BCS .3             ...Not digit, start try over
08A8- 95 0D    2240        STA GUESS+4,X      Valid, save the guessed digit
08AA- CA       2250        DEX
08AB- E0 FB    2260        CPX #-5
08AD- D0 E0    2270        BNE .1             Input next digit
08AF- 60       2280        RTS
08B0- 18       2290 .3     CLC
08B1- 60       2300        RTS
               2310 *-------------------------------
```

Automatic SETUP Revised.....Bill Morgan

Last month we presented a modification to the ProDOS S-C Macro Assembler which automatically EXEC's a SETUP file when the assembler begins execution. It's very convenient to just boot up the assembler and have everything we need installed into /RAM, but after a few days of using the new code I started wanting improvements.

One error I made last month was stating that "-" doesn't work in this circumstance. It didn't work when I first tried it, but there must have been some other problem because it does just fine now.

Once Bob started using this routine he came up with several enhancements as well. Here's the SETUP file he uses:

```
-PRODRIVE
PREFIX/RAM
BLOAD /HARD1/SCASM.SYSTEM,TSYS,A$2000
BSAVE        SCASM.SYSTEM,TSYS,A$2000,L17920
BLOAD /HARD1/UTIL.SYSTEM,TSYS,A$2000,L$4000
BSAVE        UTIL.SYSTEM,TSYS,A$2000,L$4000
BLOAD /HARD1/UTIL.SYSTEM,TSYS,A$2000,B$4000,L$26FB
BSAVE        UTIL.SYSTEM,TSYS,A$2000,B$4000,L$26FB
BLOAD /HARD1/BASIC.SYSTEM,TSYS,A$2000
BSAVE        BASIC.SYSTEM,TSYS,A$2000,L10240
BLOAD /HARD1/STARTUP,TBAS,A$801,L737
BSAVE        STARTUP,TBAS,A$801,L737
```

There are a couple of interesting things in that file. UTIL.SYSTEM is too big to BLOAD in one piece under the assembler, so he handles it in two sections, using the L and B parameters to concatenate the second piece onto the end of the first one. Another thing that didn't occur to me was to transfer an Applesoft STARTUP program with the same technique I've been using for SYS files.

One problem we ran into was restarting the assembler from /RAM and having it unnecessarily reload everything. The solution to that is to check the Global Page DEVNUM byte to see if we're coming from /RAM, and if so skip SETUP. Another improvement is to avoid manually looking up the address of the SC.INIT routine inside the assembler. By JSRing to a JMP ($8001) we can automatically call that routine, wherever it might be. We do still need to confirm that the JMP $8000 instruction that starts the assembler is located at $206A, and that the space beginning at $21B0 is empty.

```
                    1000 *SAVE S.STARTER.PLUS
                    1010 *-------------------------------
0200-               1020 WBUF          .EQ $200
                    1030
8000-               1040 SC.COLDSTART .EQ $8000
8003-               1050 SC.WARMSTART .EQ $8003
                    1060
BE03-               1070 DOSCMD        .EQ $BE03
BF30-               1080 DEVNUM        .EQ $BF30
                    1090 *-------------------------------
                    1100         .OR $206A
206A- 4C B0 21      1110         JMP STARTER
                    1120
                    1130         .OR $21B0
                    1140 STARTER
21B0- AD 30 BF      1150         LDA DEVNUM    Slot/Drive of last device used
21B3- C9 B0         1160         CMP #$B0      was it S3,D2 (/RAM)?
21B5- F0 16         1170         BEQ .3        ...yes, no need to redo SETUP
                    1180
21B7- 20 D0 21      1190         JSR SCINIT    get assembler ready
21BA- A2 00         1200         LDX #0
21BC- BD D3 21      1210 .1      LDA COMMAND,X
21BF- F0 06         1220         BEQ .2
21C1- 9D 00 02      1230         STA WBUF,X    stuff command into buffer
21C4- E8            1240         INX
21C5- D0 F5         1250         BNE .1        always
21C7- 20 03 BE      1260 .2      JSR DOSCMD    do it!
21CA- 4C 03 80      1270         JMP SC.WARMSTART  just in case
                    1280
21CD- 4C 00 80      1290 .3      JMP SC.COLDSTART
                    1300
21D0- 6C 01 80      1310 SCINIT JMP (SC.COLDSTART+1)
                    1320 *-------------------------------
21D3- AD D3 C5
21D6- D4 D5 D0      1330 COMMAND .AS -/-SETUP/
21D9- 8D 00         1340         .HS 8D00
```

Another Selector Note.....Bill Morgan

It's been a long time since we published a program that has drawn as much enthusiastic response as Bob's new ProDOS Program Selector (AAL July 86). That program is a true how-did-I-ever-get-along-without-it?

Like several other readers, I have my own small improvement to suggest. When the list of volumes available is displayed the cursor bar always comes up on the first item, which is usually /RAM, because that's how the ProDOS ONLINE call returns the list. But I nearly always want to select something from the hard disk, which is always the second item in the list. Similarly, once I have chosen a volume the cursor bar appears on the first item in the list of SYS files, which is usually PRODOS. Well most of the time I'm switching to SCASM.SYSTEM, the second item in the list. How can I make the cursor start on my default choice?

The defaults are set by the STY SEL.LINE instructions at lines 1530 and 1840, with Y=0 from the previous instructions. Therefore all I have to do to start the cursor on the second line is add two lines:

```
1525        INY
1835        INY
```

If you want to begin on some other line, just make those into LDY #n-1, where n is line you want. Note that adding two two-byte instructions uses up almost all of the extra space available, so watch out if you've made other changes.

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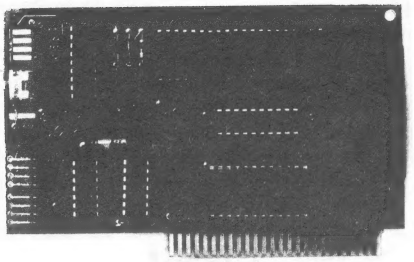

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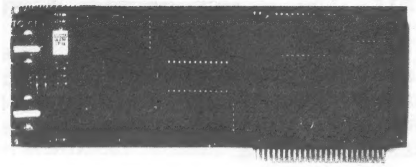

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New Rak-Ware Utility "ScreenGen".....Bob Kovacs

ScreenGen is a new utility for transfering hi-res graphics screens from the Macintosh to the Apple II. You can use the sophisticated tools of the Macintosh to easily create hi-res screens for the Apple II.

The ScreenGen program resides in the Apple II only. No special software is neede for the MAC. Any MAC screen or document that can be output to an Imagewriter printer can be transferred via ScreenGen. Since the normal Apple hi-res screen is only 280 by 192 dots, which is much smaller than the MAC screen, ScreenGen limits the amount of data transferred to fill one Apple II screen.

I am selling ScreenGen for $35, and the disk includes the commented source code in S-C Macro Assembler format. Since the source code is included, you will find it easy to adapt ScreenGen to a specific application.

Basically, ScreenGen is a developer's tool. I designed it to fulfill a specific need I had some time ago. I figure there must be a few more folks out there who could also use it.

My application involved the design of a computerized point-of-sale demonstration program used at a local Macy's department store. The program acted like a skilled musician/salesman to actively demonstrate the operation of a music keyboard. Since the keyboard had a MIDI interface it was relatively straightforward to have it play music, change the voice settings, and perform more sophisticated operations to show off all the bells and whistles. The program was interactive and menu driven.

The program operated on an Apple //c (which they also sell at Macy's) and a number of hi-res screens were needed to show pictures of the keyboard and its function keys for each part of the demonstration. I started off using MousePaint on the Apple II and found it difficult to use (let's face it, I've been spoiled by MacPaint). And so ScreenGen was born!

To use ScreenGen, you need an Apple II, II+, or //e with a SuperSerial Card, or an Apple //c (which has the serial "card" built-in). You also need a Macintosh computer with an Imagewriter serial interface cable (or equivalent cable for Apple //c). Pictures are sent from the MAC as though they are going to the printer, at 9600 baud. A complete picture takes about 15 seconds.

If ScreenGen sounds like a utility you can use in your development, you can order it directly from Rak-Ware, or from Bob at S-C Software.

Apple Assembly Line (ISSN 0889-4302) is published monthly by S-C SOFTWARE CORPORATION, P.O. Box 280300, Dallas, Texas 75228. Phone (214) 324-2050. Subscription rate is $18 per year in the USA, sent Bulk Mail; add $3 for First Class postage in USA, Canada, and Mexico; add $14 postage for other countries. Back issues are available for $1.80 each (other countries add $1 per back issue for postage). A subscription to the newsletter and the Monthly Disk containing all source code is $64 per year in the US, Canada and Mexico, and $87 to other countries.